

What is claimed is:

1. A method for forming a metal bump on a semiconductor substrate, comprising the steps of:

providing a semiconductor substrate, said semiconductor substrate having been provided in or on the surface thereof with a contact pad, said contact pad sitting on an underlying layer of dielectric and being in electrical contact with at least one point of electrical contact in or on the surface of said substrate;

depositing a layer of passivation over the surface of said layer of dielectric underlying the contact pad, including the surface of said contact pad;

patterning and etching said layer of passivation, creating an opening in said layer of passivation having a first diameter, partially exposing the surface of said contact pad over a surface area of said first diameter, said first diameter of said opening created in said layer of passivation being smaller than a surface area of said contact pad by a measurable amount;

etching said contact pad, using said layer of passivation as a mask, partially or completely first removing said contact pad from above the surface of said layer of dielectric, creating a opening in said contact pad having a diameter being about equal to said first diameter;

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sputtering a layer of Under Bump Metallurgy (UBM) over the surface of said layer of passivation, including said opening created in said contact pad;

depositing and patterning a layer of photoresist, creating an opening in the photoresist with a slightly larger dimension than said first diameter;

electroplating a layer of bump metal in the photoresist opening;

stripping the layer of photoresist and etching said layer of UBM, using said layer of bump metal as a mask; and

reflowing the surface of said layer of bump metal, forming the metal bump.

2. The method of claim 1 wherein said opening created in said contact pad has a depth that is less than a height of said contact pad by a measurable amount.

3. The method of claim 1 wherein said opening created in said contact pad has a depth that is equal to a height of said contact pad.

4. The method of claim 1 wherein said contact pad comprises aluminum or copper or a compound thereof.

5. The method of claim 1 further comprising the additional step of electroplating an enhanced UBM layer, after creating said opening in said layer of photoresist, and prior to electroplating said layer of bump metal.

6. The method of claim 1 wherein said contact pad is accessed by means of interconnect metal being provided in a plane of said contact pad and overlying said layer of dielectric.

7. The method of claim 1 wherein said contact pad is accessed by means of at least one via provided through said layer of dielectric.

8. A method for forming a metal bump on a semiconductor substrate, comprising the steps of:

providing a semiconductor substrate, said semiconductor substrate having been provided in or on the surface thereof with a contact pad, said contact pad sitting on an underlying layer of dielectric;

depositing a layer of passivation over the surface of said layer of dielectric, including the surface of said contact pad;

patterning and etching said layer of passivation, creating an opening in said layer of passivation having a first diameter, partially exposing the surface of said contact pad over a surface

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area of said first diameter, said first diameter of said opening created in said layer of passivation being smaller than a surface area of said contact pad by a measurable amount;

depositing a layer of polyimide over the surface of said layer of passivation, including the opening created in said layer of passivation;

patterning and etching said layer of polyimide, creating an opening in said layer of polyimide having a second diameter, partially exposing the surface of said contact pad over a surface area of said second diameter, said second diameter of said opening created in said layer of polyimide being smaller than said first diameter by a measurable amount;

etching said contact pad, using said layer of polyimide as a mask, partially or completely removing said contact pad from above the surface of said layer of dielectric, creating an opening in said contact pad having a diameter being about equal to said second diameter;

sputtering a layer of Under Bump Metallurgy (UBM) over the surface of said layer of polyimide, including said opening created in said contact pad;

depositing and patterning a layer of photoresist, creating an opening in said layer of photoresist with a slightly larger dimension than said second diameter;

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electroplating a layer of bump metal in the opening created in said layer of photoresist;  
stripping said layer of photoresist;  
etching said layer of UBM, using said layer of bump metal as a mask; and  
reflowing the surface of said layer of bump metal, forming the metal bump.

9. The method of claim 8 wherein said opening created in said contact pad has a depth that is less than a height of said contact pad by a measurable amount.

10. The method of claim 8 wherein said opening created in said contact pad has a depth that is equal to a height of said contact pad.

11. The method of claim 8 wherein said contact pad comprises aluminum or copper or a compound thereof.

12. The method of claim 8 further comprising the additional step of electroplating an enhanced UBM layer, after creating said opening in said layer of photoresist, and prior to electroplating said layer of bump metal.

13. The method of claim 8 wherein said contact pad is accessed by means of interconnect metal being provided in a plane of said contact pad and overlying said layer of dielectric.

14. The method of claim 8 wherein said contact pad is accessed by means of at least one via provided through said layer of dielectric down to the surface of said semiconductor surface.

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15. A method for forming a metal bump on a semiconductor substrate, comprising the steps of:

providing a semiconductor substrate, said semiconductor substrate having been provided on the surface thereof with a contact pad, said contact pad overlying a layer of dielectric, said layer of dielectric having been deposited over said semiconductor substrate; and

partially removing said contact pad, said removing having a removal thickness and removal surface area.

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16. The method of claim 15 wherein said removal surface area of said contact pad is smaller than a surface area of said contact pad by a measurable amount.

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17. The method of claim 15 wherein said removal thickness of said contact pad is less than a height of said contact pad by a measurable amount.

18. The method of claim 15 wherein said removal thickness of said contact pad equals a height of said contact pad.

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19. The method of claim 15 wherein said partially removing said contact pad comprises the steps of:

depositing a layer of passivation over the surface of said layer of dielectric, including the surface of said contact pad;

patterning and etching said layer of passivation, creating an opening in said layer of passivation having a first diameter, partially exposing the surface of said contact pad over a surface area of said first diameter, said first diameter of said opening created in said layer of passivation being smaller than a surface area of said contact pad by a measurable amount; and

etching said contact pad, using said layer of passivation as a mask, creating an opening in said contact pad having a second diameter, partially or completely first removing said contact pad from above the surface of said layer of dielectric, said second diameter of said first opening created in said contact pad being about equal to said first diameter of said opening created in said layer of passivation.

20. The method of claim 19 with additional steps of:

sputtering a layer of Under Bump Metallurgy (UBM) over the surface of said layer of passivation, including said first opening created in said contact pad, leaving in place a layer of said UBM overlying said contact pad;

depositing and patterning a layer of photoresist, creating an opening in said layer of photoresist with a slightly larger diameter than said first diameter;

electroplating a layer of bump metal in said opening created in said layer of photoresist;

stripping the layer of photoresist and blanket etching said layer of UBM; and

reflowing the surface of said layer of bump metal, forming the metal bump.

21. The method of claim 20 wherein said layer of Under Bump Metallurgy comprises a plurality of sub-layers of different metallic composition.

22. The method of claim 15 wherein said contact pad comprises aluminum or copper or a compound thereof.



23. The method of claim 20 with the additional step of electroplating an enhanced layer of UBM, after creating the opening in said layer of photoresist, and prior to the electroplating of said layer of bump metal.

24. The method of claim 19 with additional steps of evaporation of UBM and solder by applying stencil techniques, comprising the steps of:

patterning and etching a stencil with holes having a diameter being equal to said first diameter, said holes in said stencil having positions that are identical to positions of said contact pads on the surface of said substrate;

aligning said stencil with said the surface of substrate, said holes created in said stencil being aligned with corresponding contact pads;

depositing by evaporation a layer of UBM over the surface of said substrate, using said stencil as a mask;

depositing by evaporation a layer of bump metal over the surface of said layer of UBM;

removing said stencil from said aligned position with said surface of said substrate; and

reflowing the surface of said layer of bump metal, forming said metal bumps.

25. The method of claim 19 with additional steps of evaporation of UBM and solder by applying screen printing, comprising the steps of:

patterning and creating a screen with holes having a diameter being equal to said first diameter, said holes in said stencil having positions that are identical to positions of said contact pads on the surface of said substrate;

sputtering a layer of UBM over the surface of said layer of passivation, including said first opening created in said contact pad;

aligning said screen with the surface of said substrate, said holes created in said screen being aligned with corresponding contact pads;

screen printing a layer of solder cream using said screen as a mask;

removing said screen from said aligned position with said surface of said substrate;

blanket etching said sputtered layer of UBM; and

reflowing the surface of said layer of bump metal, forming said metal bumps.

26. The method of claim 15 wherein said contact pad is accessed by means of interconnect metal being provided in a plane of said contact pad and overlying said layer of dielectric.

27. The method of claim 15 wherein said contact pad is accessed by means of at least one via provided through said layer of dielectric.

28. A method for forming a metal bump on a semiconductor substrate, comprising the steps of:

providing a semiconductor substrate, said semiconductor substrate having been provided on the surface thereof with a contact pad, said contact pad overlying a layer of dielectric, said layer of dielectric having been deposited over said semiconductor substrate; and

partially removing said contact pad, said removing having a removal thickness and removal surface area.

29. The method of claim 28 wherein said removal surface area of said contact pad is smaller than a surface area of said contact pad by a measurable amount.

30. The method of claim 28 wherein said removal thickness of said contact pad is less than a height of said contact pad by a measurable amount.

31. The method of claim 28 wherein said removal thickness of said contact pad equals a height of said contact pad.

32. The method of claim 28 wherein said partially removing said contact pad comprises the steps of:

depositing a layer of passivation over the surface of said layer of dielectric, including the surface of said contact pad;

patterning and etching said layer of passivation, creating an opening in said layer of passivation having a first diameter, partially exposing the surface of said contact pad over a surface area of said first diameter, said first diameter of said opening created in said layer of passivation being smaller than a surface area of said contact pad by a measurable amount;

depositing a layer of polyimide over the surface of said layer of passivation, including the opening created in said layer of passivation;

patterning and etching said layer of polyimide, creating an opening in said layer of polyimide having a second diameter, partially exposing the surface of said contact pad over a surface area of said second diameter, said second diameter of said

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opening created in said layer of polyimide being smaller than said first diameter by a measurable amount; and

etching said contact pad, using said layer of polyimide as a mask, partially or completely removing said contact pad from above the surface of said layer of dielectric, creating an opening in said contact pad having a diameter being about equal to said second diameter.

33. The method of claim 32 with additional steps of:

sputtering a layer of Under Bump Metallurgy (UBM) over the surface of said layer of polyimide, including said opening created in said contact pad;

depositing and patterning a layer of photoresist, creating an opening in said layer of photoresist with a slightly larger dimension than said second diameter;

electroplating a layer of bump metal in the opening created in said layer of photoresist;

stripping said layer of photoresist;

etching said layer of UBM, using said layer of bump metal as a mask; and

reflowing the surface of said layer of bump metal, forming the metal bump.

34. The method of claim 33 wherein said layer of Under Bump Metallurgy comprises a plurality of sub-layers of different metallic composition.

35. The method of claim 28 wherein said contact pad comprises aluminum or copper or a compound thereof.

36. The method of claim 33 with the additional steps of electroplating an enhanced layer of UBM, after creating the opening in said second layer of photoresist, and prior to the electroplating of said layer of bump metal.

37. The method of claim 28 wherein said contact pad is accessed by means of interconnect metal being provided in a plane of said contact pad and overlying said layer of dielectric.

38. The method of claim 28 wherein said contact pad is accessed by means of at least one via provided through said layer of dielectric.

39. The method of claim 32 with additional steps of evaporation of UBM and solder by applying stencil techniques, comprising the steps of:

patterning and etching a stencil with holes having a diameter being equal to said first diameter, said holes in said stencil having positions that are identical to positions of said contact pads on the surface of said substrate;

aligning said stencil with said the surface of substrate, said holes created in said stencil being aligned with corresponding contact pads;

depositing by evaporation a layer of UBM over the surface of said substrate, using said stencil as a mask;

depositing by evaporation a layer of bump metal over the surface of said layer of UBM;

removing said stencil from said aligned position with said surface of said substrate; and

reflowing the surface of said layer of bump metal, forming said metal bumps.

40. The method of claim 32 with additional steps of evaporation of UBM and solder by applying screen printing, comprising the steps of:

patterning and creating a screen with holes having a diameter being equal to said first diameter, said holes in said stencil having positions that are identical to positions of said contact pads on the surface of said substrate;

sputtering a layer of UBM over the surface of said layer of passivation, including said first opening created in said contact pad;

aligning said screen with the surface of said substrate, said holes created in said screen being aligned with corresponding contact pads;

screen printing a layer of solder cream using said screen as a mask;

removing said screen from said aligned position with said surface of said substrate;

blanket etching said sputtered layer of UBM; and

reflowing the surface of said layer of bump metal, forming said metal bumps.